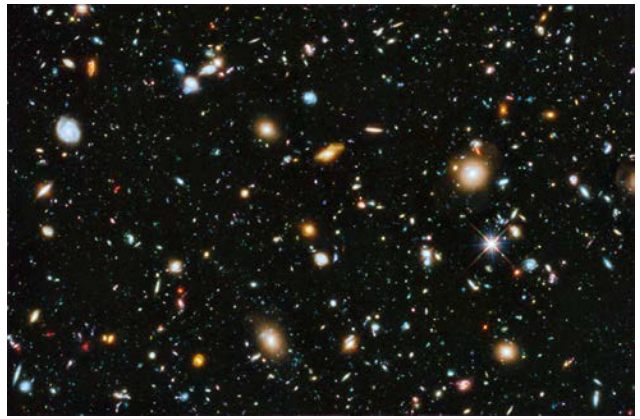
Paul Hertz
Felicia Chou
Patricia Knezek
Kartik Sheth
Hashima Hasan
Mario Perez
Eric Smith
Doug Hudgins
Rita Sambruna

National Aeronautics and Space Administration

ASTROPHYSICS

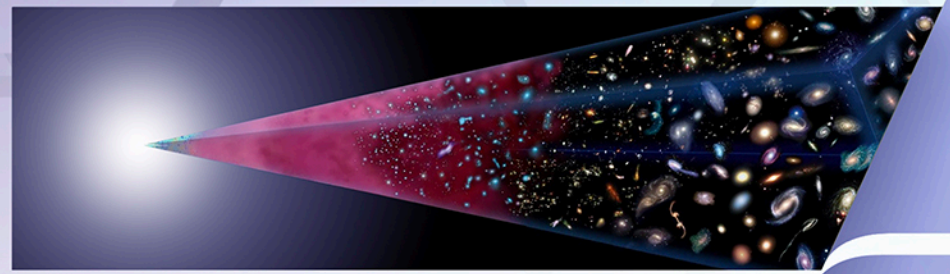
NASA Town Hall

AAS 232nd Meeting
Denver, Colorado
June 4, 2018

This presentation is posted at
http://science.nasa.gov/astrophysics/documents/

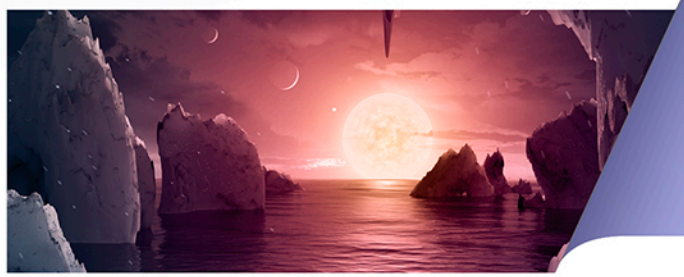
Paul Hertz
Director, Astrophysics Division
Science Mission Directorate
@PHertzNASA

Why Astrophysics?



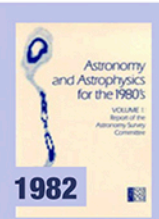
How did our universe begin and evolve?

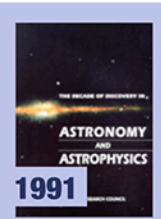
How did galaxies, stars, and planets come to be?



Are we alone?

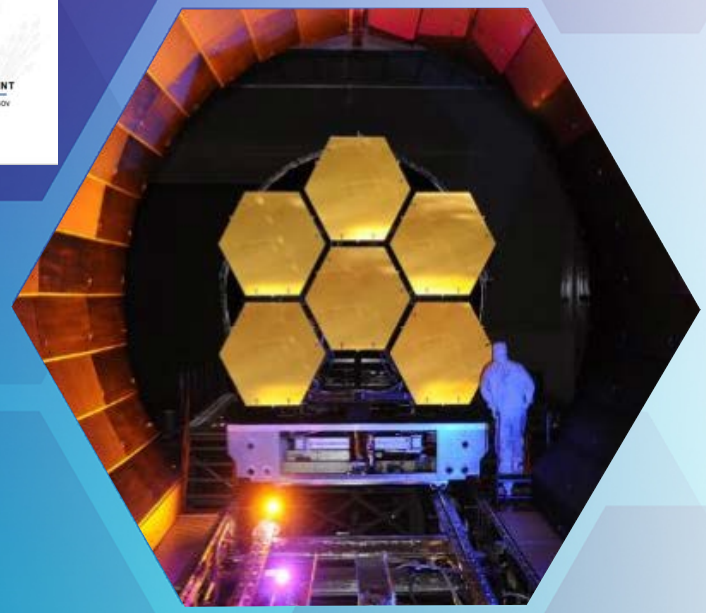
Enduring National Strategic Drivers





Astrophysics is humankind's scientific endeavor to understand the universe and our place in it.

ASTROPHYSICS



Outline

- Overview
  - NASA at AAS Meeting
  - Diversity and Inclusion
- Program and Budget Update
  - Science Highlights
  - Budget Update
  - R&A Update
- Missions Update
  - TESS
  - Webb
  - WFIRST
  - Explorers
  - Senior Review
- Planning for Astro2020

NASA-related events at the 232nd AAS Meeting

- Infrared Astrophysics in the SOFIA Era I – Mon 10:40 am & Mon 2:50 pm & Tue 10:40 am in Governor's Square 12
- NASA Town Hall – Mon 1:40 pm in Plaza Ballroom E
- The Promise of Multi-messenger Astrophysics Town Hall, Mon 6:40 pm in Plaza Ballroom E
- Preparing for JWST Science with the Early Release Science Programs – Tue 10:40 am & Tue 2:50 pm & Wed 10:40 am & Wed 2:40 pm in Governor's Square 11
- Astrophysics Archives in the 2020's – Tues 2:50 pm in Governor's Square 16
- STScI Town Hall – Wed 1:40 pm in Plaza Ballroom E
- Contributions from NASA's Nancy Grace Roman Technology Fellows – Wed 2:50 pm in Governor's Square 10

NASA Astrophysics Diversity and Inclusion

- The NASA Astrophysics Division is actively taking steps to advance diversity, inclusion, and equal opportunity in the NASA workforce and among NASA grantee institutions.
- NASA Astrophysics is committed to:
  - Setting the expectancy of diversity and inclusion in the composition of: proposal teams, peer review panels, science and technology definition teams, and mission and instrument teams.
  - Recruiting diversity on NASA-selected groups (e.g., advisory groups, peer review panels, science teams).
  - Recruiting a diverse Astrophysics Division staff.
  - Working with the NASA Office of the Chief Scientist and our peer review contractors to address unconscious bias in peer reviews.
  - Establishing a Code of Conduct for peer review panel chairs and members
  - Sharing best practices in peer reviews with other agencies.
  - Observing the demographics of R&A proposers and awardees as an indicator of issues.
- The demographics of R&A proposers and awardees – we notice that:
  - The inferred gender balance of awardees does reflect that of proposers.
  - The inferred gender balance of proposers does not always reflect that of the community.

NASA's Universe of Learning

An Integrated Astrophysics STEM Learning and Literacy Program

SONOMA STATE UNIVERSITY

CHANDRA X-RAY OBSERVATORY

STScI | SPACE TELESCOPE SCIENCE INSTITUTE

ipac

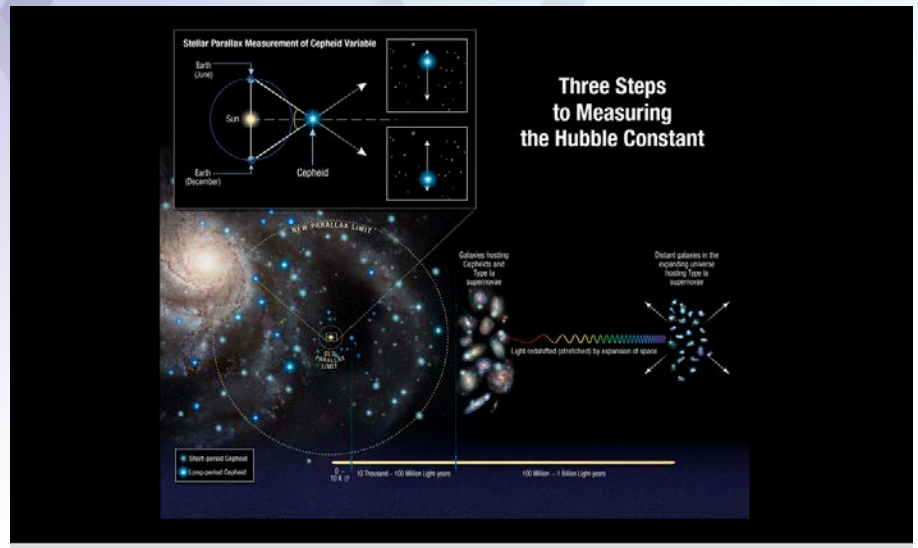
JPL
Jet Propulsion Laboratory
California Institute of Technology

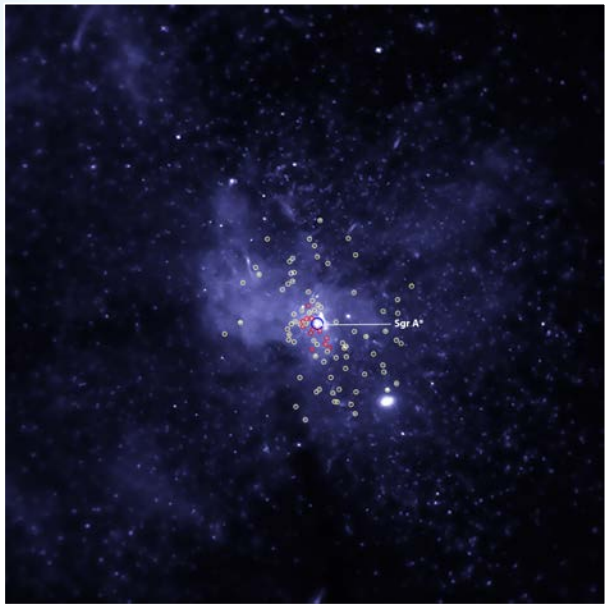
Keep informed about NASA

- NSPIRES mailing list – information about NASA solicitations
  - https://nspires.nasaprs.com/
- Cosmic Origins mailing list, Exoplanet Exploration mailing list, Physics of the Cosmos mailing list – information about NASA missions and science
  - https://cor.gsfc.nasa.gov/cornews-mailing-list.php
  - https://exoplanets.nasa.gov/exep/exopag/announcementList/
  - https://pcos.gsfc.nasa.gov/pcosnews-mailing-list.php
- NASA Astrophysics Federal Advisory Committees
  - Astrophysics Advisory Committee (APAC) https://science.nasa.gov/researchers/nac/science-advisory-committees/apac
  - NAS Committee on Astronomy and Astrophysics (CAA) http://sites.nationalacademies.org/bpa/bpa_048755
  - Astronomy and Astrophysics Advisory Committee (AAAC) https://www.nsf.gov/mps/ast/aaac.jsp
- Sign up to be a panel reviewer:
  - https://science.nasa.gov/researchers/volunteer-review-panels

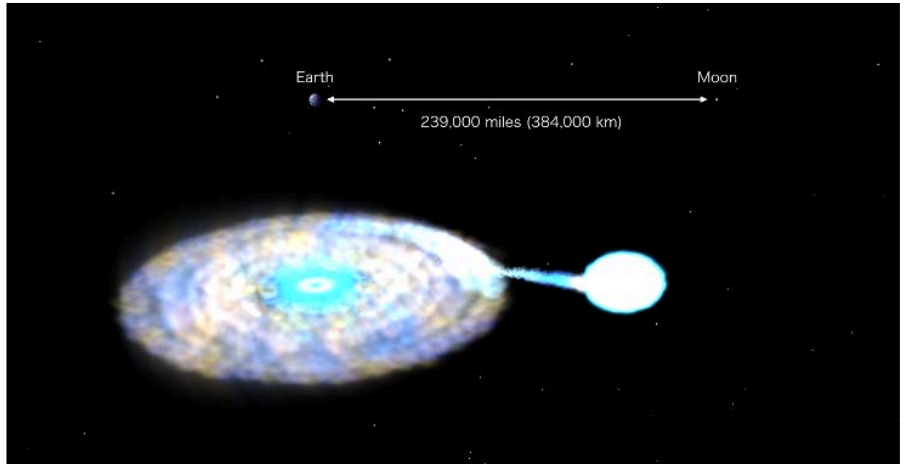
NASA Astrophysics
Program and Budget Update

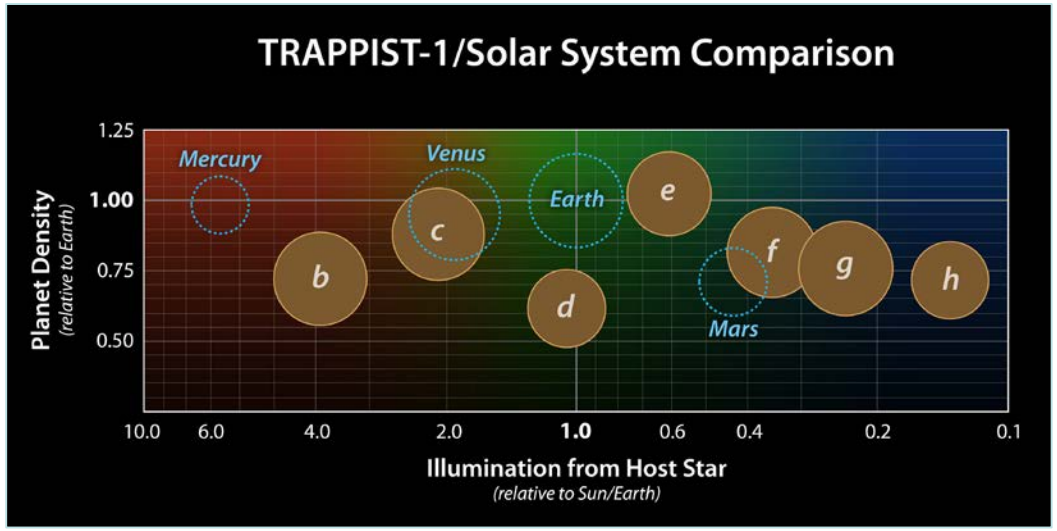
Some NASA Science Stories of 2018





UL: Hubble
UR: Chandra
LL: NICER
LR: Hubble & Spitzer





Major Accomplishments: June 2017 – May 2018

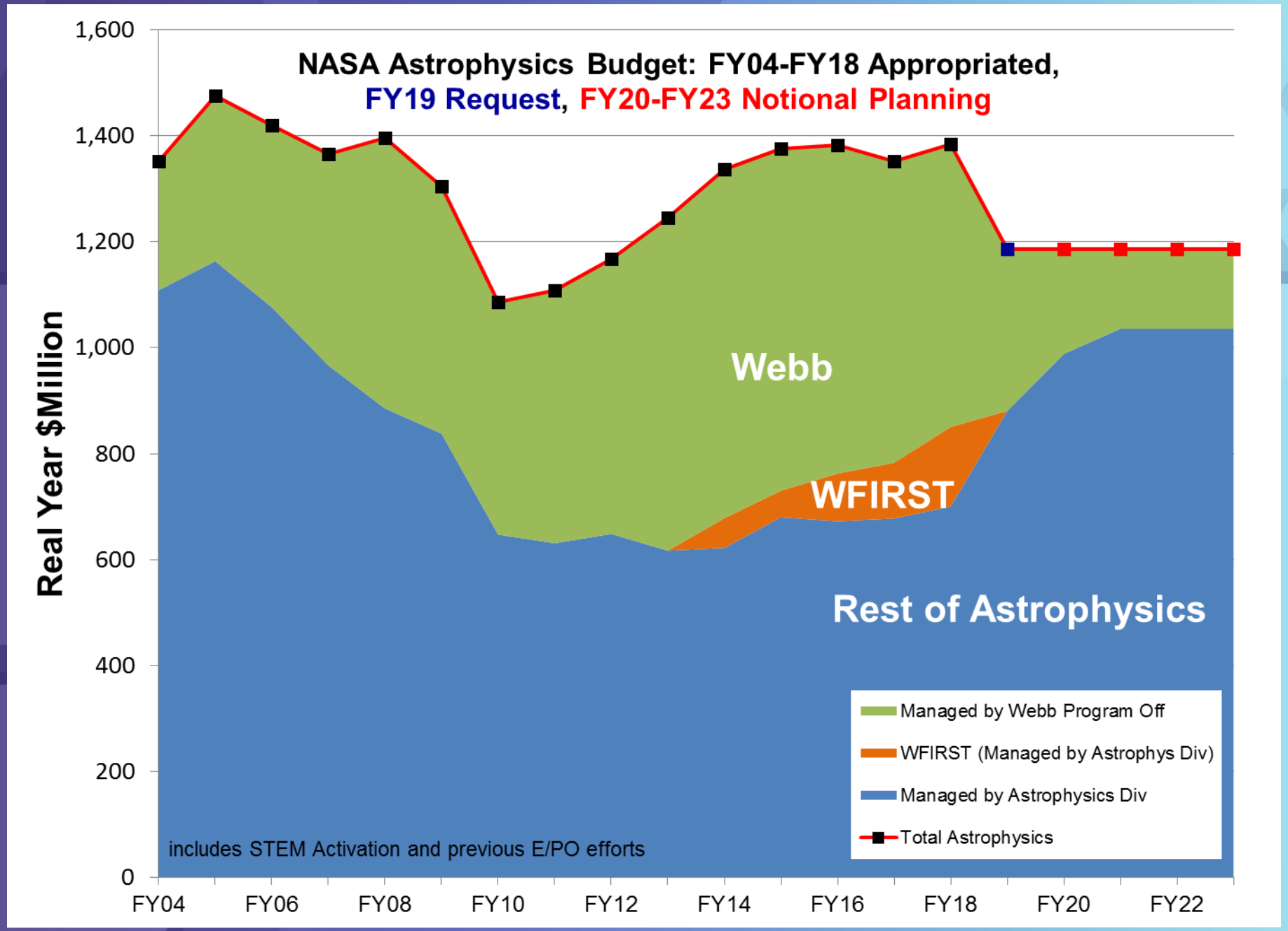
- Two missions launched to International Space Station (ISS)
  - Neutron Star Interior Composition Explorer (NICER) June 2017
  - Cosmic Ray Energetics and Mass (CREAM) August 2017
- Arcus/FINESSE/SPHEREx Medium-class Explorer (MIDEX) and CASE/COSI-X/TAO-ISS Mission of Opportunity (MO) proposals selected August 2017 for competitive Phase A concept studies
- Widefield Infrared Survey Telescope (WFIRST) Independent External Technical/Management/Cost Review (WIETR) completed October 2017; WFIRST directed to reduce cost
- Webb payload completed cryotesting December 2017; Webb sunshield integrated with spacecraft January 2018; Webb payload shipped January 2018
- X-ray Astronomy Recovery Mission (XARM) passed KDP-C January 2018 and began implementation (Phase C)
- Webb launch delay announced and Webb Independent Review Board (WIRB) formed March 2018
- Transiting Exoplanet Survey Satellite (TESS) launched April 2018
- WFIRST passed KDP-B May 2018 and began preliminary design phase (Phase B); funds appropriated by Congress in FY18 will allow WFIRST to begin Phase B

Planned Accomplishments June 2018 – June 2019

- Webb Independent Review Board will report in June 2018, and NASA will submit Webb replan cost and schedule report to Congress
- IXPE will complete preliminary design review and enter Phase C August 2018
- Next Astrophysics MIDEX and Mission of Opportunity missions will be downselected by January 2019
- Astrophysics Decadal Survey will begin January 2019
- Astrophysics Senior Review will be conducted Spring 2019
- Next Astrophysics SMEX and Mission of Opportunity AO will be released in Spring 2019
- Webb observatory integration in 2019

Astrophysics Budget Overview

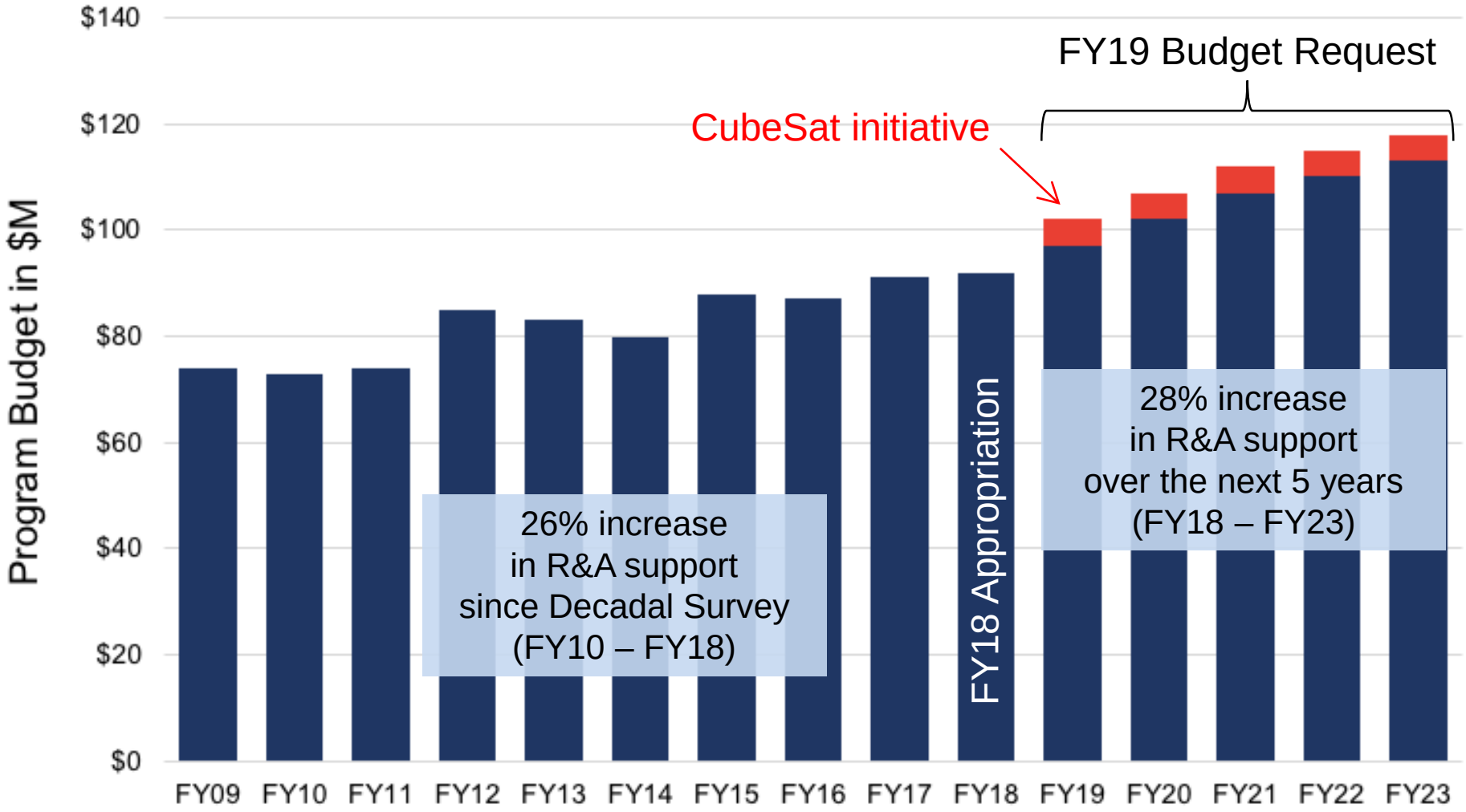
- The FY18 consolidated appropriation provides funding for NASA Astrophysics to continue its planned programs, missions, projects, research, and technology.
  - Total funding provided for FY18 (Astrophysics including Webb) rises from $1.352B in FY17 to $1.384B in FY18, an increase of ~$32M (2.4%) from FY17.
  - The NASA Astrophysics FY18 appropriation funds Webb for progress toward launch, WFIRST formulation into Phase B, Explorers mission development and SMEX AO, increased funding for R&A, continued operating missions, suborbital missions and CubeSats, technology development, and mission studies.
  - $10M (2.2%) reduction in rest of Astrophysics to accommodate directed spending increases for WFIRST, Hubble, and SOFIA.
- The FY19 budget request proposes a reduced level of funding for NASA Astrophysics.
  - Total requested funding for FY19 (Astrophysics including Webb) is ~$1.185B, a reduction of $200M (14%) from FY18 appropriation.
  - Webb included as project within Astrophysics budget, integration and testing continues toward launch.
  - Given its significant cost within a proposed lower budget for Astrophysics and competing priorities within NASA, WFIRST is terminated with remaining WFIRST funding redirected towards competed astrophysics missions and research.


NASA Astrophysics Budget: FY04-FY18 Appropriated,
FY19 Request, FY20-FY23 Notional Planning
Real Year $Million
1,600
1,400
1,200
1,000
800
600
400
200
0
FY04
FY06
FY08
FY10
FY12
FY14
FY16
FY18
FY20
FY22
Webb
WFIRST
Rest of Astrophysics
includes STEM Activation and previous E/PO efforts
Managed by Webb Program Off
WFIRST (Managed by Astrophys Div)
Managed by Astrophysics Div
Total Astrophysics

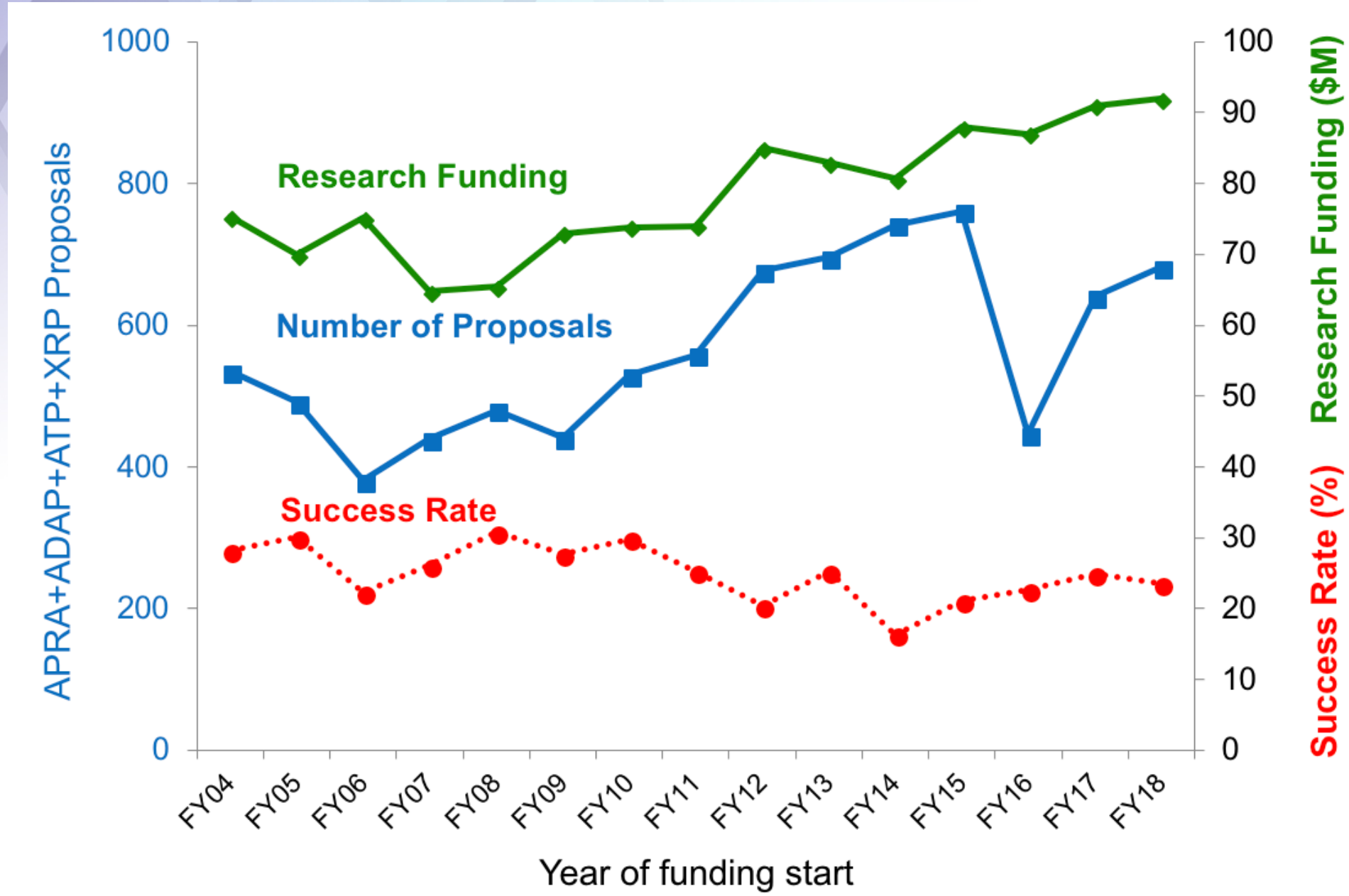
NASA Astrophysics
Research and Analysis Update

Growth in R&A Funding

Program	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23
R&A	$74	$73	$74	$85	$83	$80	$88	$87	$91	$92	$97	$102	$107	$110	$113
CubeSat											$5	$5	$5	$5	$5
Total	$74	$73	$74	$85	$83	$80	$88	$87	$91	$92	$102	$107	$112	$115	$118



Proposal Pressure



Proposal Status Update

GO Selection Rate = 30%
R&A Selection Rate = 23%

Status: June 1, 2018

Solicitation	Proposal Due Date	Notify Date	Days since received	Number received	Number selected	% selected
Chandra GO – Cycle 19	Mar 16, 2017	July 10, 2017	116	574	155	27%
Roman Tech Fellowship	Mar 17, 2017	Sep 8, 2017	175	12	2	17%
SAT (Technology)	Mar 17, 2017	Sep 8, 2017	175	30	9	30%
APRA (Basic Research)	Mar 17, 2017	Sep 8, 2017	175	141	53	38%
Hubble GO – Cycle 25	Apr 7, 2017	June 26, 2017	80	971	271	28%
ADAP (Data Analysis)	May 16, 2017	Sep 11, 2017	118	264	43	16%
Exoplanet Research	May 25, 2017	Oct 8, 2017	136	50	9	18%
SOFIA GI – Cycle 6	June 30, 2017	Nov 7, 2017	130	198	104	53%
Astrophysics Theory	July 27, 2017	Dec 22, 2017	148	216	53	25%
Webb Early Release Science	Aug 18, 2017	Nov 13, 2017	87	106	13	12%
Swift GI – Cycle 14	Sep 28, 2017	Jan 13, 2018	140	146	30	21%
TESS – Cycle 1	Oct 6, 2017	Feb 3, 2018	132	143	38	27%
K2 – Cycle 6	March 9, 2018		53	105		
NESSF-18	Feb 1, 2018	May 15, 2018	103	176	8	5%
XARM Participating Scientist	Dec 13, 2017	Feb 21, 2018	64	39	5	13%
NuSTAR – Cycle 4	Jan 19, 2018	April 17, 2018	88	196	83	42%
TCAN	Jan 26, 2018		126	32		
Segmented Telescope Design	Feb 1, 2018	March 16, 2018	44	5	2	40%
Fermi GI – Cycle 11	Feb 23, 2018	May 26, 2018	92	138	42	30%
Spitzer GI – Cycle 14	March 23, 2018	May 29, 2018	67	116	50	43%
ADAP (Data Analysis)	May 17, 2018		15	246		

Look-ahead to R&A in 2018/2019

- New ROSES element for LISA Preparatory Science (LPS) now open
  - Proposals due 6/14/18
- New ROSES element for Astrophysics Science SmallSat Studies now open
  - Proposals due 7/13/18
- Next Astrophysics Theory Program (ATP) solicitation in 2019
  - ATP solicitations are in alternate years
- ROSES element for TESS GI program
  - Cycle 1 selections announced, 38 proposals selected
  - Cycle 2 proposals due 10/3/18
- New ROSES element for NICER GO program is planned
  - After NICER completes prime mission in June
- Continue best practices in managing our R&A programs, reviews, and awards, including:
  - Actively taking steps to advance diversity, inclusion, and equal opportunity in the NASA workforce and among NASA grantee institutions
  - Created a Code of Conduct for peer review Panelists and Chairs which is being used in all reviews

NASA Astrophysics

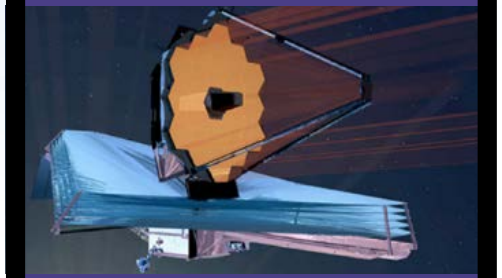
Missions Update: TESS, Webb, WFIRST

Astrophysics Missions in Development

TESS — 4/2018
NASA Mission

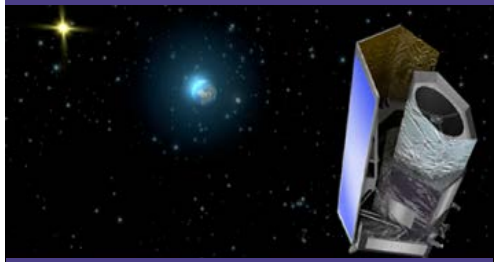
Transiting Exoplanet Survey Satellite

Webb — 2020
NASA Mission



James Webb Space Telescope

Euclid — 2021
ESA-led Mission

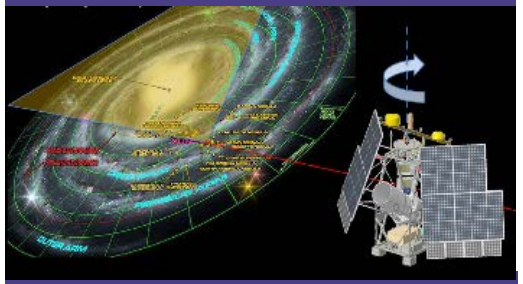


NASA is supplying the NISP Sensor Chip System (SCS)

IXPE — 2021
NASA Mission

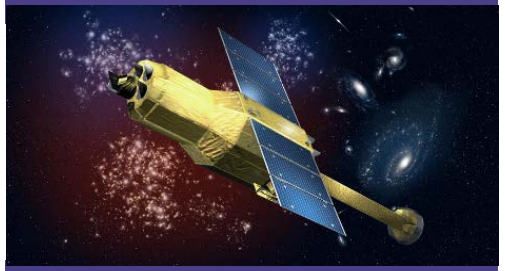
Imaging X-ray Polarimetry Explorer

GUSTO — 2021
NASA Mission



Galactic/ Extragalactic ULDB Spectroscopic Terahertz Observatory

XARM — 2021
JAXA-led Mission



NASA is supplying the SXS Detectors, ADRs, and SXTs

MIDEX/MO — 2022/ 2023
NASA Mission

Arcus, FINESSE, or SPHEREx CASE, COSI-X, or ISS-TAO

WFIRST — Mid 2020s
NASA Mission

Wide-Field Infrared Survey Telescope

TESS

Transiting Exoplanet
Survey Satellite

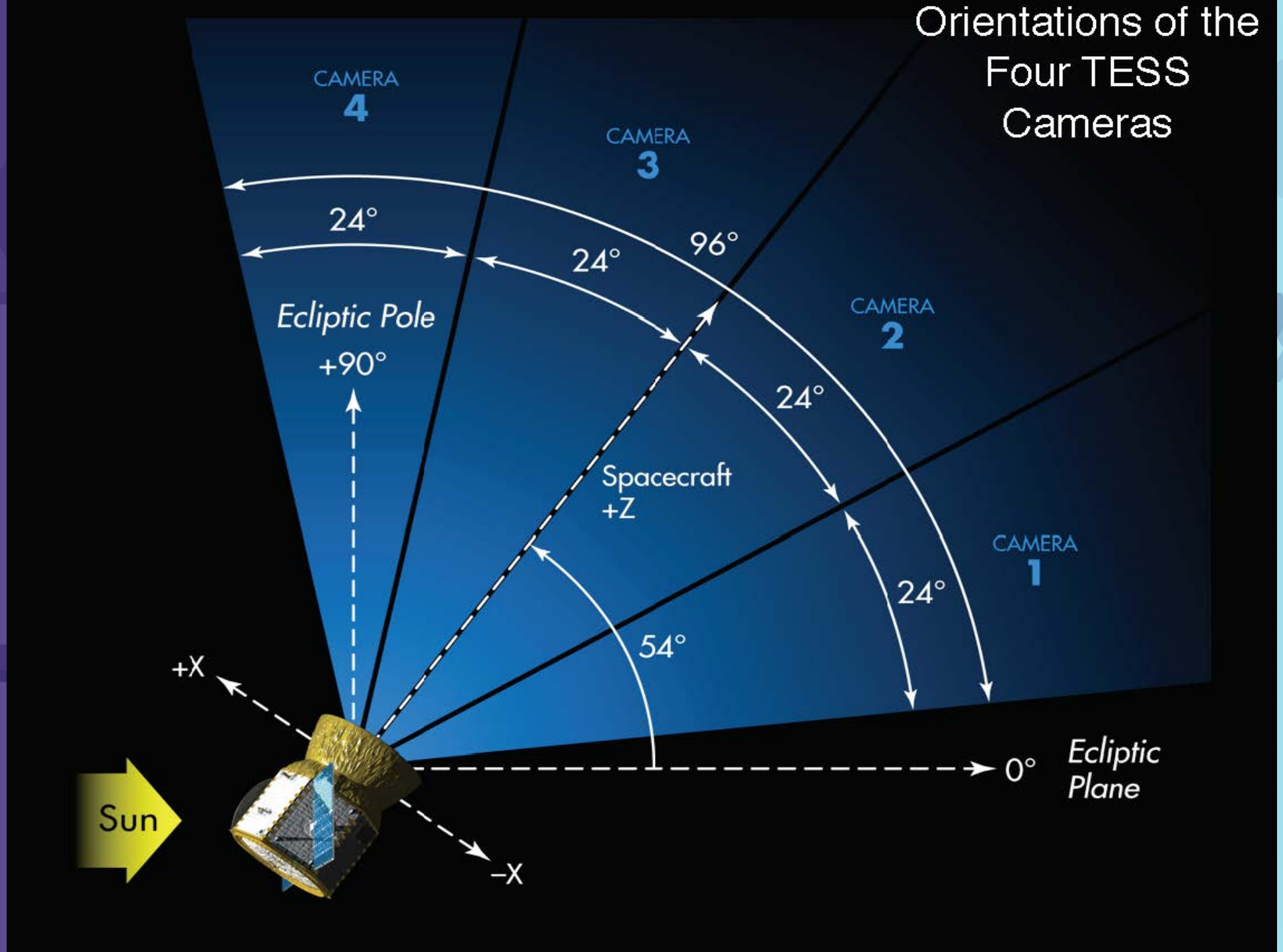
https://tess.gsfc.nasa.gov/
https://tess.mit.edu/

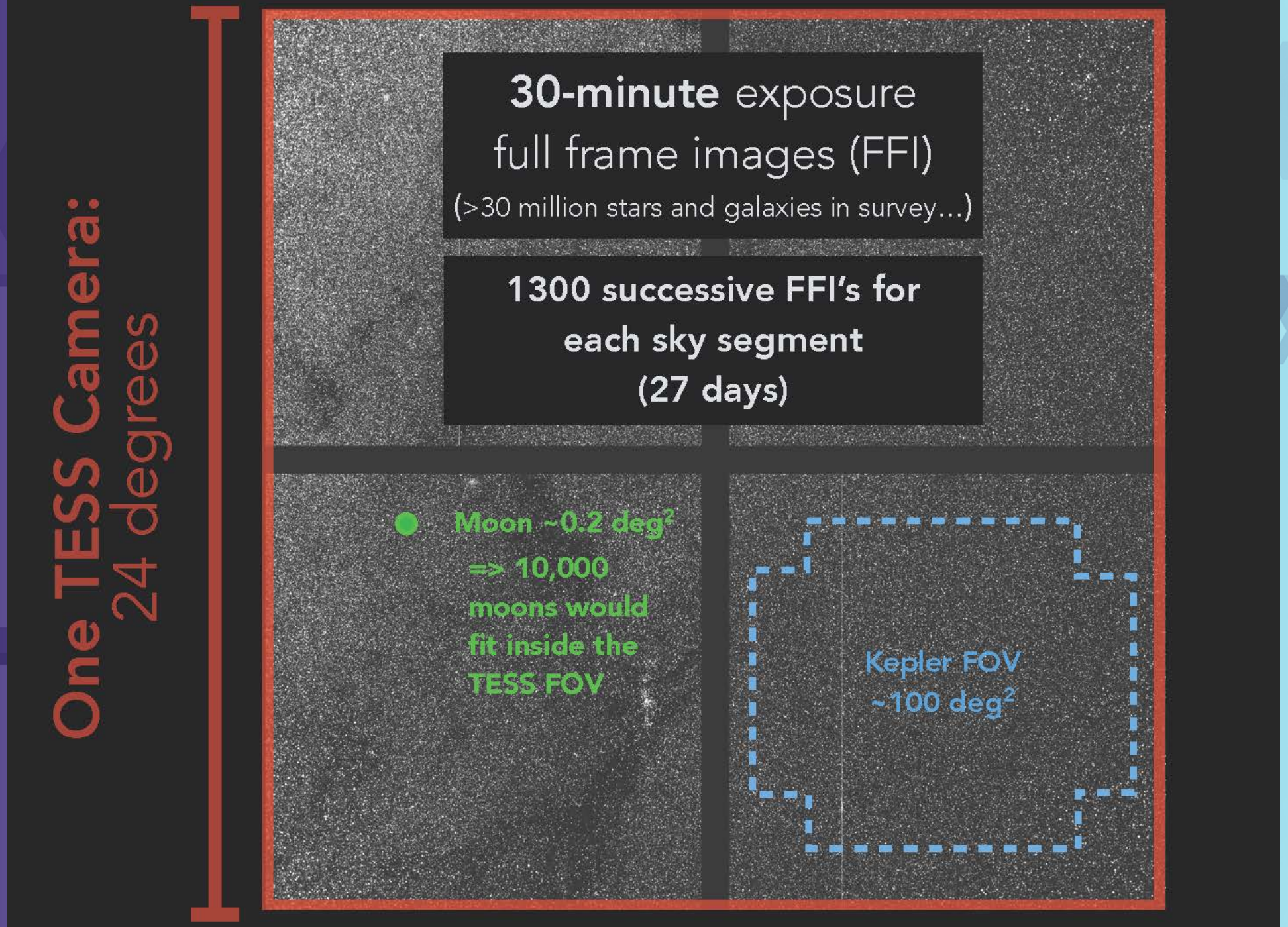
TESS

Transiting Exoplanet Survey Satellite

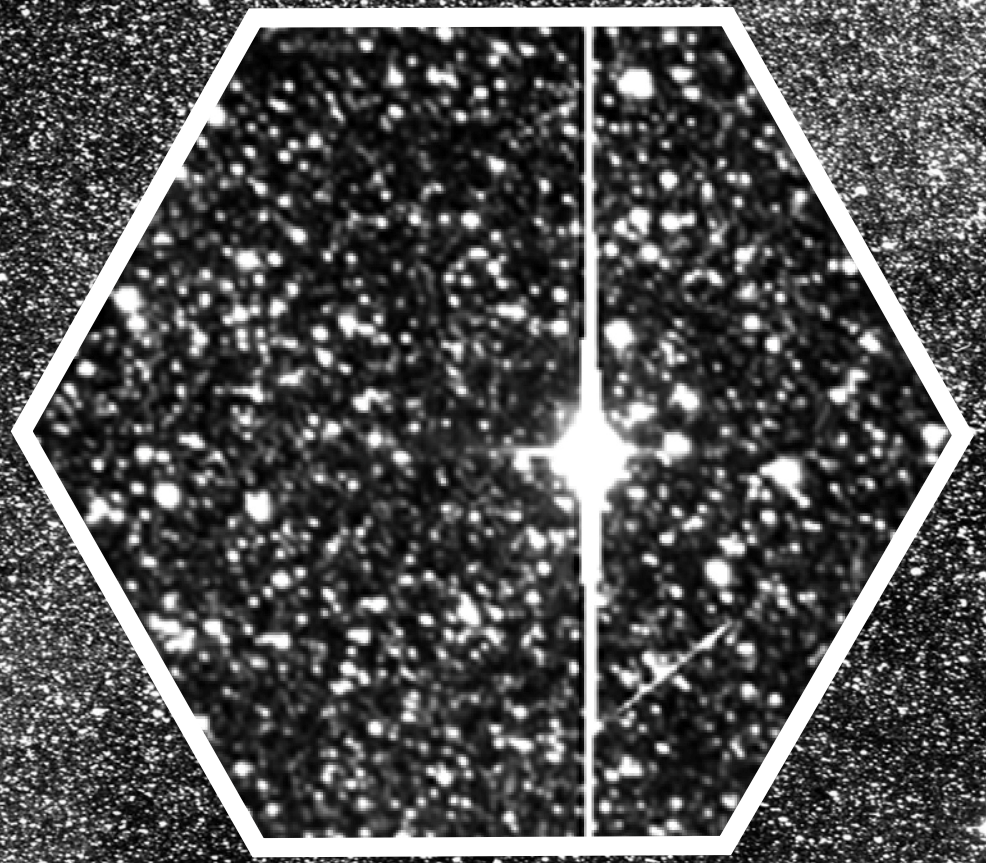
Launched April 18, 2018

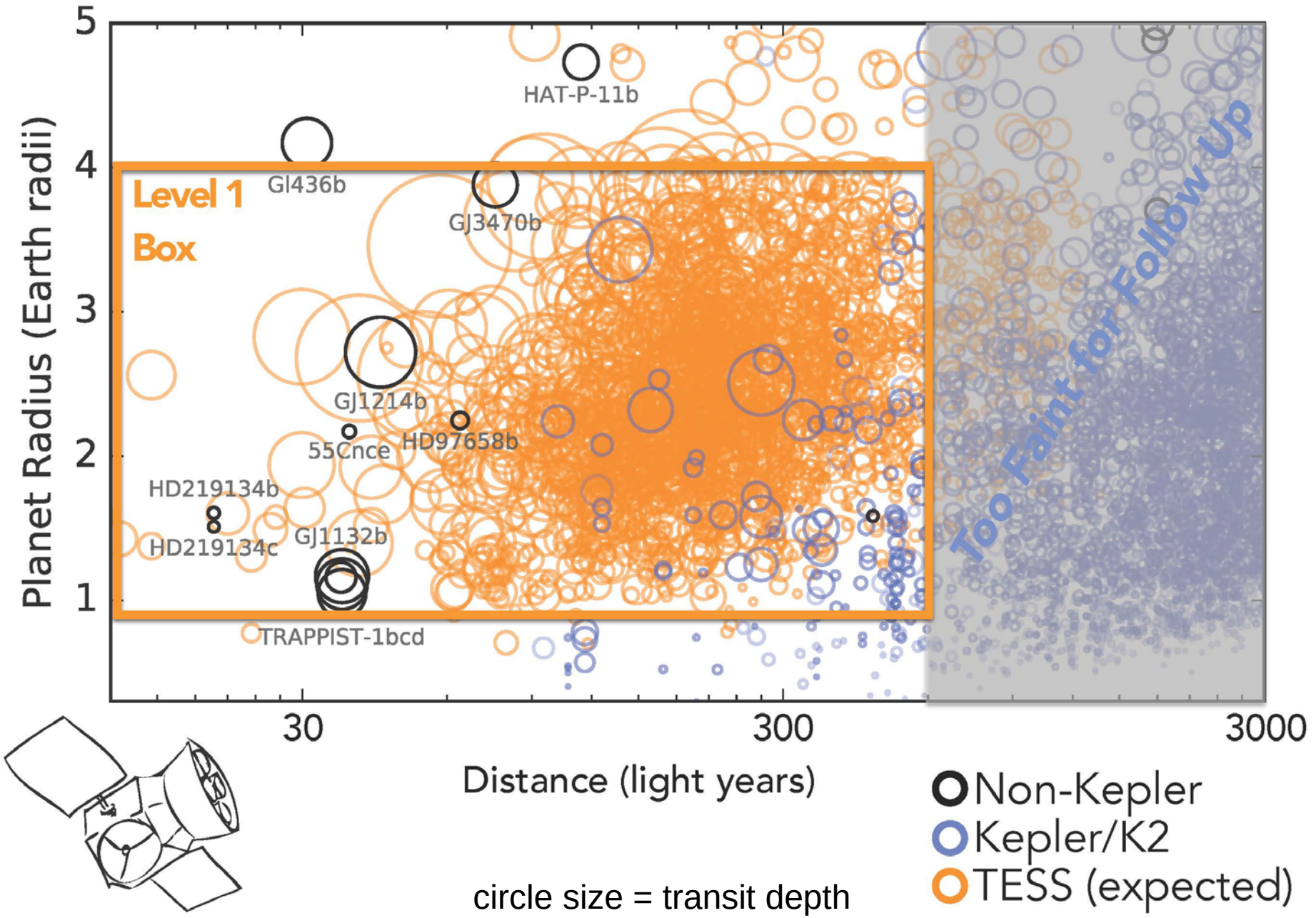
https://tess.gsfc.nasa.gov/
https://tess.mit.edu/


Orientations of the Four TESS Cameras
CAMERA 4
CAMERA 3
CAMERA 2
CAMERA 1
24°
24°
96°
24°
24°
24°
Ecliptic Pole
+90°
Spacecraft +Z
54°
+X
-X
Sun
0°
Ecliptic Plane

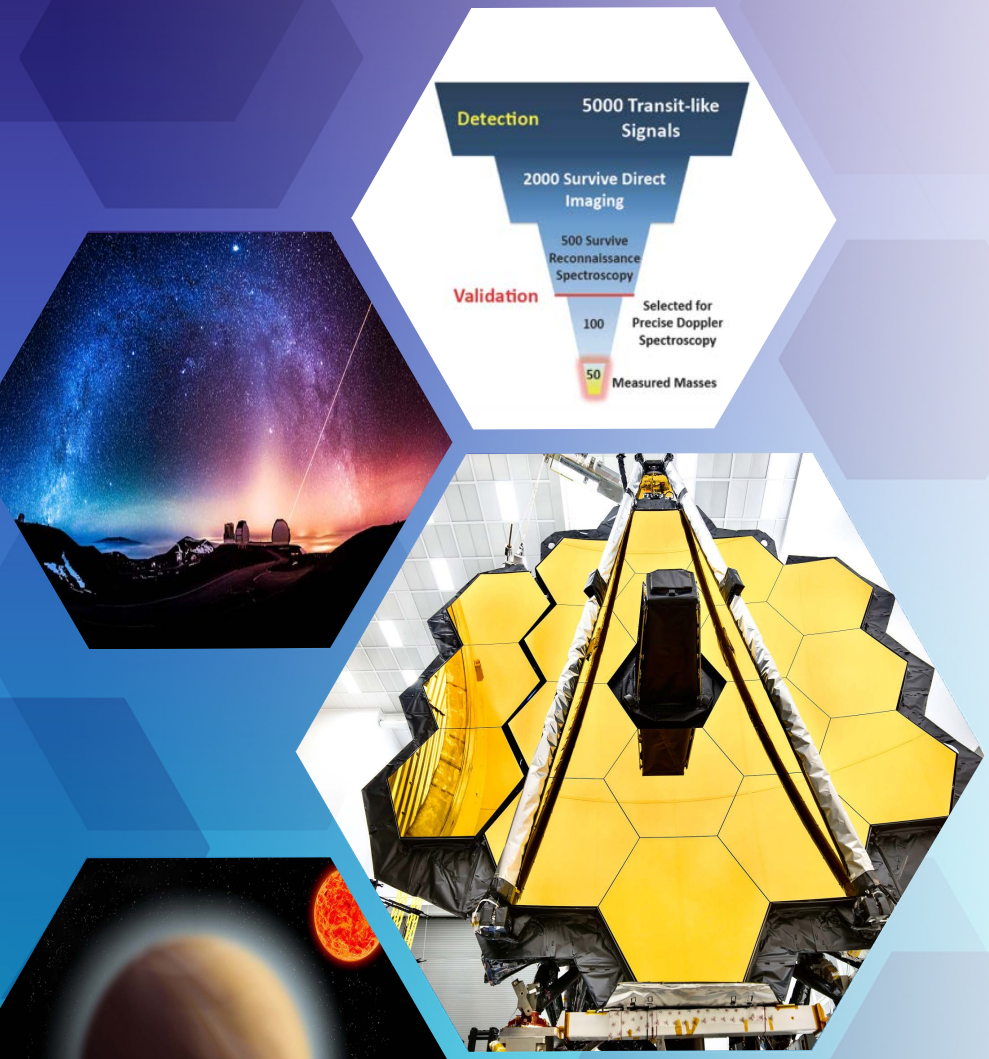

One TESS Camera:
24 degrees
30-minute exposure
full frame images (FFI)
(>30 million stars and galaxies in survey…)
1300 successive FFI's for
each sky segment
(27 days)
Moon ~0.2 deg²
=> 10,000
moons would
fit inside the
TESS FOV
Kepler FOV
~100 deg²

TESS 2-sec coarse-point test image




Planet Radius (Earth radii)
5
4
3
2
1
HAT-P-11b
Gl436b
GJ3470b
Level 1
Box
GJ1214b
55Cnce
HD97658b
HD219134b
HD219134c
GJ1132b
TRAPPIST-1bcd
Too Faint for Follow Up
30
300
3000
Distance (light years)
Non-Kepler
Kepler/K2
TESS (expected)
circle size = transit depth

TESS Follow-up Program



- Ground-based follow-up program required for
  - Confirmation of exoplanet candidates
  - False-positive identification
  - Host star characterization
  - Planet mass determination

- Space-based follow-up program required for
  - Atmosphere detection
  - Molecule detection and atmosphere characterization for planets down to super-Earth sizes (Webb)

TESS Guest Investigator Program

- The TESS GI program will maximize the science return from the TESS mission, for exoplanet discovery, and many other areas of astrophysics
- TESS Cycle 1 (southern ecliptic hemisphere) GI investigations have been selected
  - Cycle 1 projects cover asteroids, stellar oscillations, flares, exoplanet studies, compact objects, blazars, and more
  - More than 140 proposals received, requesting ~100,000 targets
- There are opportunities for synergy with all of NASA's operating missions
- Cycle 2 (northern ecliptic hemisphere) proposals will be due December 2018

https://heasarc.gsfc.nasa.gov/docs/tess

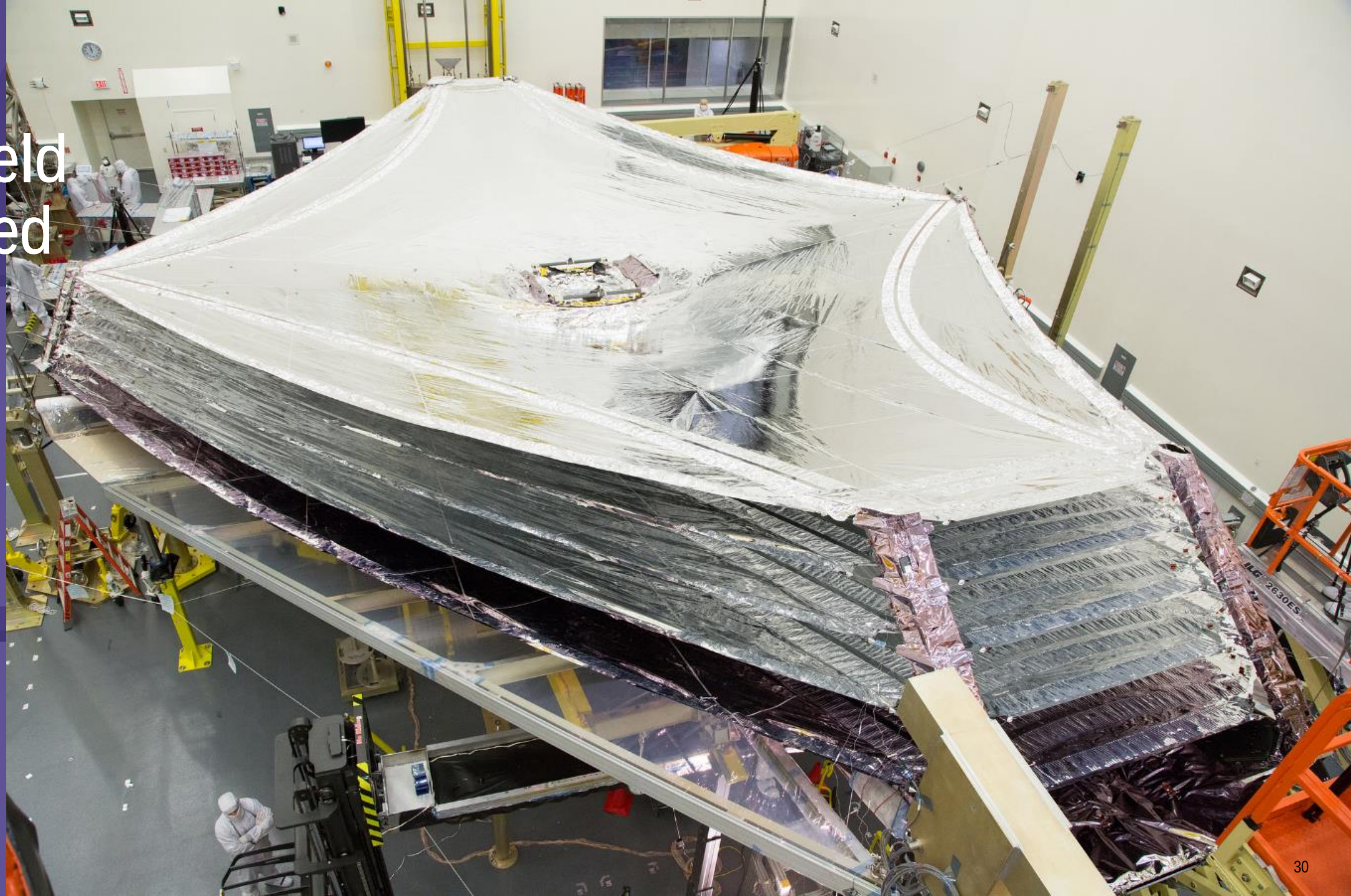
Webb

The James Webb Space Telescope

March 2018, Webb prepares for additional testing at Northrop Grumman in Redondo Beach, CA

Webb Sunshield Deployed

Fall 2017



Webb OTIS after Thermal Vacuum Testing

Nov 2017

Transporting Webb OTIS to NGAS California

Feb 2018

Webb Mission Status - March 23, 2018

Webb Observatory Elements at Northrop Grumman (NGAS) Redondo Beach, CA

Spacecraft Element in Acoustics Facility

Apr 2018

Blue font indicates “first time” activities

Remaining I&T Activities

Science Payload

- OTIS Deployments at NGAS (secondary mirror & ISIM radiator)

Observatory Integration

- Pre-environmental Observatory deployments
- Observatory fold & stow
- *Observatory system (electrical) test*
- Observatory vibration, acoustics tests
- *Observatory deployment*
- Observatory stow for launch
- Observatory final system test

Spacecraft Element

- *Acoustics, vibe, and thermal vacuum tests*
- Post-Environment deployment and stow

Webb Independent Review Board (WIRB)

- External team to evaluate all factors influencing mission success, including
  - Those identified by the Project and Standing Review Board
  - The approach to completing Integration and Test (I&T), launch campaign, and commissioning of the Webb telescope.
- Deliverable - Non-consensus final report with observations, findings, concerns, and recommendations
- The WIRB final report and NASA's response to the WIRB report will be released in late June.

WIRB Members

- Mr. Thomas Young, NASA/Lockheed Martin in Bethesda, Maryland – Retired (Chair)
- Dr. William Ballhaus, Aerospace Corporation, El Segundo, California- Retired
- Mr. Steve Battel, Battel Engineering, Inc., Scottsdale, Arizona
- Mr. Orlando Figueroa, NASA Headquarters and Goddard Space Flight Center, Greenbelt, Maryland – Retired
- Dr. Fiona Harrison, Caltech University, Pasadena, California
- Ms. Michele King, NASA Office of Chief Financial Officer/Strategic Investments Division, Washington, DC
- Mr. Paul McConnaughey, NASA/Marshall Space Flight Center/Webb Standing Review Board (Chair), Huntsville, Alabama
- Ms. Dorothy Perkins, NASA Goddard Space Flight Center, Greenbelt, Maryland - Retired
- Mr. Pete Theisinger, Jet Propulsion Laboratory, Pasadena, California
- Dr. Maria Zuber, Massachusetts Institute of Technology, Cambridge, Massachusetts

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- Mr. Dan Woods, NASA, Washington, DC (Review Manager)
- Dr. John Karcz, NASA, Washington, DC (Executive Secretary)

Webb Summary

- Spacecraft Element (Sunshield + Spacecraft bus)
  - In environmental test program, completed shock separation test and acoustics testing. Test instrumentation data indicate successful tests.
  - Analyzing post-acoustics hardware status after detailed inspections showed some membrane cover hardware (fasteners) came loose
- OTIS (Optical Telescope + Integrated Science instruments)
  - Post cryo-test deployment and electrical testing underway
- Programmatic
  - Webb Independent Review Board (WIRB) completing review, will report to NASA in June 2018
  - Agency final decision on launch date, incorporating WIRB findings, test results, and schedule assessment targeted for end of June
- Science
  - Cycle 1 General Observer proposal due date moved to NET February 2019

WFIRST

Wide Field Infrared Survey Telescope

Primary mirror assembly / Harris Corporation

WFIRST Update

- Conducted WFIRST Independent External Technical/Cost/Management Review (WIETR) in response to National Academies' Midterm Assessment
- WFIRST directed by SMD AA in November 2017 to reduce cost and complexity sufficient to have a cost estimate consistent with $3.2B cost target set at Phase A beginning
  - Coronagraph is technology demonstration instrument
  - Independent cost assessment validated estimated cost of rescoped mission, consistent with $3.2B cost target
- WFIRST passed SRR/MDR, approved in May 2018 to enter Phase B (preliminary design phase)

WFIRST Update (2)

- Given its significant cost within a proposed lower budget for Astrophysics and competing priorities within NASA, the President's FY19 Budget Request proposes that WFIRST be terminated with remaining WFIRST funding redirected towards competed astrophysics missions and research
- Funds appropriated by Congress in FY18 will allow WFIRST to begin Phase B in May 2018
- If Congress adopts the Administration's request to terminate WFIRST, the funds made available would enable a competed mission AO in FY19

Comparison of Webb and WFIRST Development Risk at KDP-B

Webb @ KDP-B	WFIRST @ KDP-B
Novel, complex segmented Be mirror development	Existing 2.4m monolithic ULE mirror
Numerous technology developments	High TRL: basis of Decadal selection, recent investments
Complex cryo-cooler	Passive Al radiator
ISIM structure materials development (30 K)	Reuse of Webb design in instrument carrier (190K)
IR detector manufacturing problem uncovered after KDP-C	IR detectors presently at TRL-6, flight growth initiated at start of Phase B; Greater maturity and understanding of Webb-derived detector technologies reduces risk of encountering problems late in the WFIRST program
Four highly configurable instruments (inherent complexity), major international roles, separate guider	Single primary instrument + tech demo, no separate guider
Many complex deployments	Standard deployments

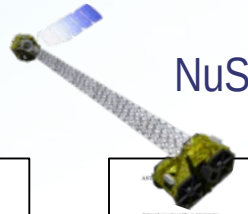
WFIRST risks are lower than those retired on Webb, and typical of high TRL missions. Incorporated numerous Webb lessons learned.

WFIRST Science

- NASA considering changes in WFIRST key programs and how observing time will be determined
  - Three key science pillars (Dark Energy, Exoplanets, Great Observatory Astrophysics) all important; no specific amounts of observing time reserved for specific science pillars, surveys, or observing programs
  - Allocation of WFIRST observing time through open-access, nonproprietary, peer-reviewed competition of programs addressing scientific imperatives of 2020s, including dark energy and exoplanets; observing program will be selected as close in time to observations as possible
  - Investigate alternate ways of organizing community-based key project teams
  - Consider openly-competed “Early Release Demonstration Programs” performed at start of WFIRST operations to inform peer-reviewed time allocation process during prime mission
- WFIRST Formulation Science Working Group (FSWG) is reviewing proposed change

Astrophysics Explorers Program

Swift



NuSTAR

NICER

ANNOUNCEMENT OF OPPORTUNITY

EXPLORER 2011

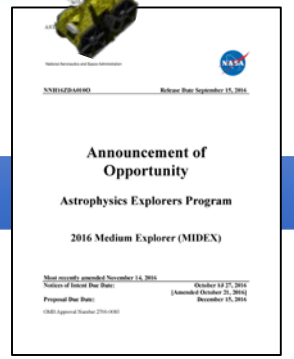
MIDEX
2011

Announcement of Opportunity

Astrophysics Explorers Program

2014 Small Explorer (SMEX)

SMEX
2014



Announcement of Opportunity

Astrophysics Explorers Program

2016 Medium Explorer (MIDEX)

MIDEX
2016

Announcement of Opportunity

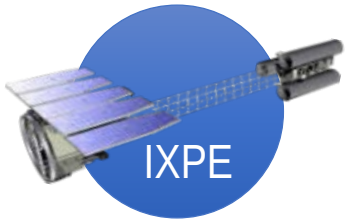
Astrophysics Explorers Program

2019 2014 Small Explorer (SMEX)

SMEX
2019
(planned)

Small and Mid-Size Missions

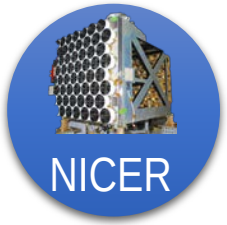
TESS



IXPE

Arcus
~~FINESSE~~
SPHEREx

Missions of Opportunity



NICER

GUSTO

CASE*
COSI-X
ISS-TAO

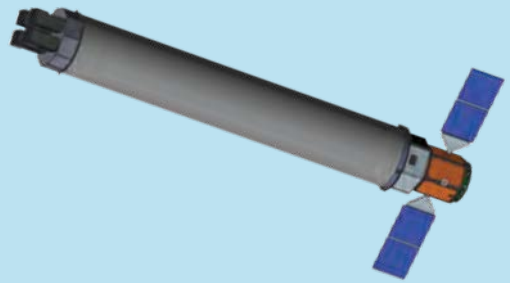
Directed
2017

XARM

* CASE partners with ARIEL selected as ESA's M4 mission

Astrophysics Explorers in Competitive Phase A

Arcus
PI: R. Smith/SAO

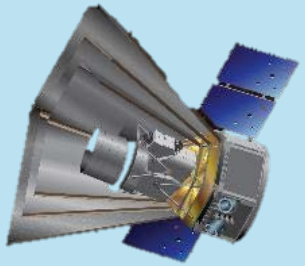


High resolution x-ray spectroscopy to explore the origin of galaxies

FINESSE
PI: M. Swain/JPL

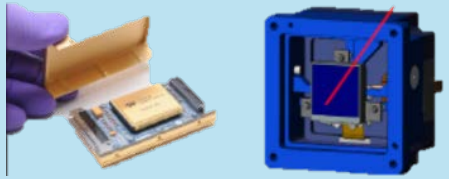
IR transit spectroscopy to explore exoplanet atmospheres

SPHEREx
PI: J. Bock/Caltech



NIR spectral survey addressing cosmology, galaxy evolution, and origin of ices

CASE
PI: M. Swain/JPL

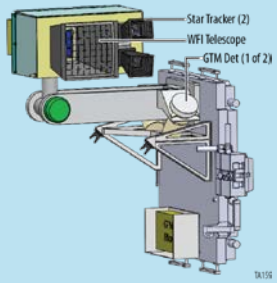


Contribution of detectors to ESA's ARIEL

COSI-X
PI: S. Boggs/UCB

ULDB balloon mission to study origin of elements in the galaxy

ISS-TAO
PI: J. Camp/GSFC



All-sky x-ray survey to study transients and search for GW sources

2019 Explorers AOs: SMEX and Missions of Opportunity

- Next Astrophysics Explorers AOs will be issued in Spring 2019
- Small Explorers (SMEX) missions
  - PI-managed Cost Cap: $195M (FY20$) including launch
  - NASA-provided launch (ELV or ISS) for $50M charge
  - PI-provided alternative access to space permitted
- Missions of Opportunity
  - PI-managed Cost Cap: $75M (FY20$) for: Partner MOs, New Missions with Existing Spacecraft MOs, Small Complete Mission MOs
  - PI-managed Cost Cap: $35M for: Suborbital-class MOs, SmallSat MOs
- Community Announcement coming soon
- Draft AOs planned for late 2018

NASA Astrophysics

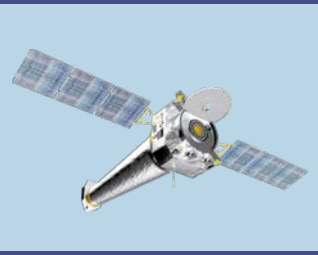
2019 Astrophysics Senior Review

Astrophysics Missions in Operation

Hubble 4/90
NASA Strategic Mission

Hubble Space Telescope

Chandra 7/99
NASA Strategic Mission



Chandra X-ray Observatory

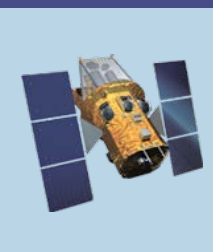
XMM-Newton 12/99
ESA-led Mission

X-ray Multi Mirror - Newton

Spitzer 8/03
NASA Strategic Mission

Spitzer Space Telescope

Gehrels-Swift 11/04
NASA MIDEX Mission

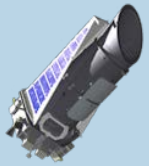


Swift Gamma-ray Burst Explorer

Fermi 6/08
NASA Strategic Mission

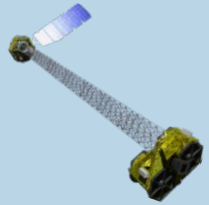
Fermi Gamma-ray
Space Telescope

Kepler 3/09
NASA Discovery Mission



Kepler Space Telescope

NuSTAR 6/12
NASA SMEX Mission

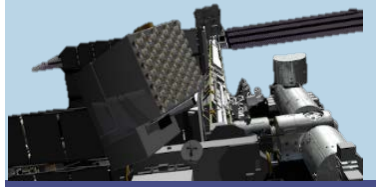


Nuclear Spectroscopic
Telescope Array

SOFIA 5/14
NASA Strategic Mission

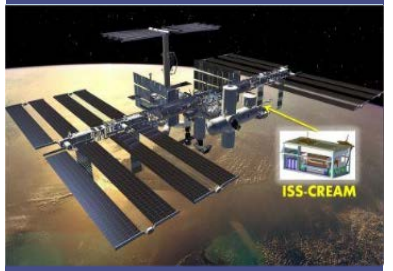
Stratospheric Observatory
for Infrared Astronomy

ISS-NICER 6/17
NASA Explorers Miss. of Oppty



Neutron Star Interior
Composition Explorer

ISS-CREAM 8/17
NASA Research Mission



Cosmic Ray Energetics
And Mass

TESS 4/18
NASA MIDEX Mission

Transiting Exoplanet
Survey Satellite

Senior Review Paradigm:

- NASA conducts regular reviews of its operating science missions in order to assess their continued science productivity and whether their operations should be continued through approval of a mission extension.
  - The NASA Authorization Act of 2005 (P.L. 109-155) states that “The Administrator shall carry out biennial reviews within each of the Science divisions to assess the cost and benefits of extending the date of the termination of data collection for those missions that have exceeded their planned mission life time.” The NASA Transition Authorization Act of 2017 (P.L. 115-10) modified the cadence to be triennial reviews.
- These reviews of operating missions are NASA’s highest form of peer review, as the subject is not a single science investigation, or even a single space mission, but rather a portfolio of operating missions.
  - The reviews of operating missions are referred to as senior reviews, in recognition of the high level of the peer review.

Senior Review 2019

- Chandra X-ray Observatory
- Fermi Gamma-ray Space Telescope
- Hubble Space Telescope
- Neutron star Interior Composition ExploreR (NICER)
- Nuclear Spectroscopic Telescope Array (NuSTAR)
- Stratospheric Observatory for Infrared Astronomy (SOFIA) [pending clarification of Congressional language]
- Neil Gehrels Swift Observatory
- Transiting Exoplanet Survey Satellite (TESS)
- X-ray Multi-mirror Mission-Newton (XMM-Newton)

Senior Review 2019

NASA Astrophysics Advisory Committee

Senior Review Subcommittee

- Rest-of-Missions Panel
- Chandra Panel
- Hubble Panel
- SOFIA Panel (TBD)

Senior Review 2019 Schedule

2018:

- ✓ APAC approves Terms of Reference for the Senior Review Subcommittee
- Establish Senior Review Subcommittee, including appointment of subcommittee members compliant with FACA
- Draft call for proposals issued
- Final call for proposals issued

2019:

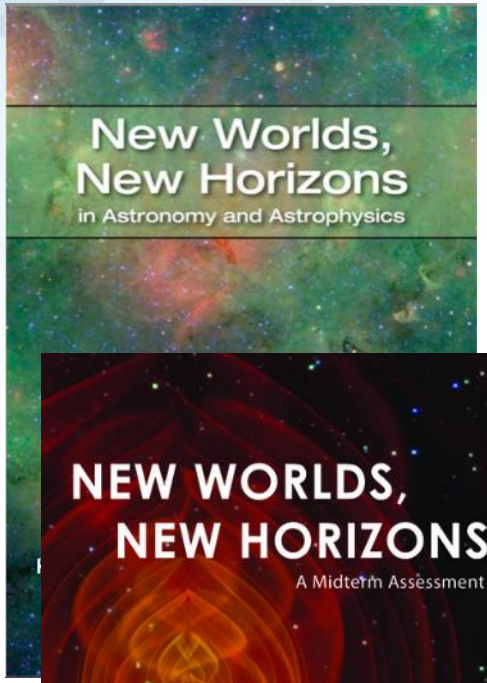
- Senior Review proposals due
- Rest-of-missions, Chandra, Hubble, and SOFIA* panels meet
- Reports from Rest-of-missions, Chandra, Hubble, and SOFIA* panels due to Senior Review Subcommittee
- Senior Review Subcommittee meets
- Senior Review Subcommittee reports to APAC
- APAC delivers formal recommendations to NASA
- NASA responds to Senior Review and provides direction to projects

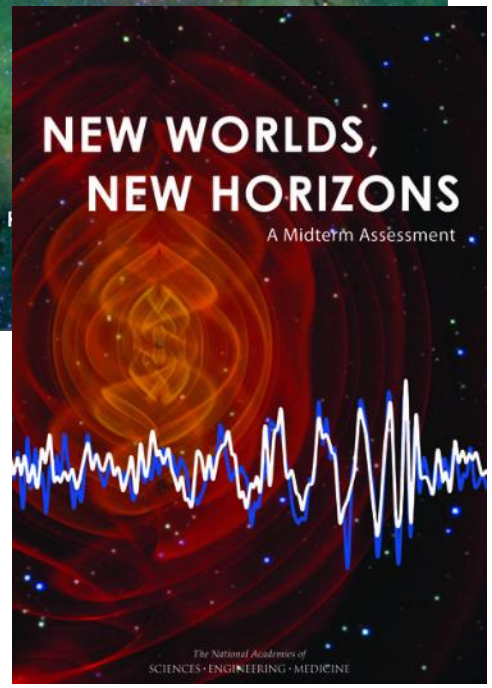
** Deposition dependent on final Congressional language*

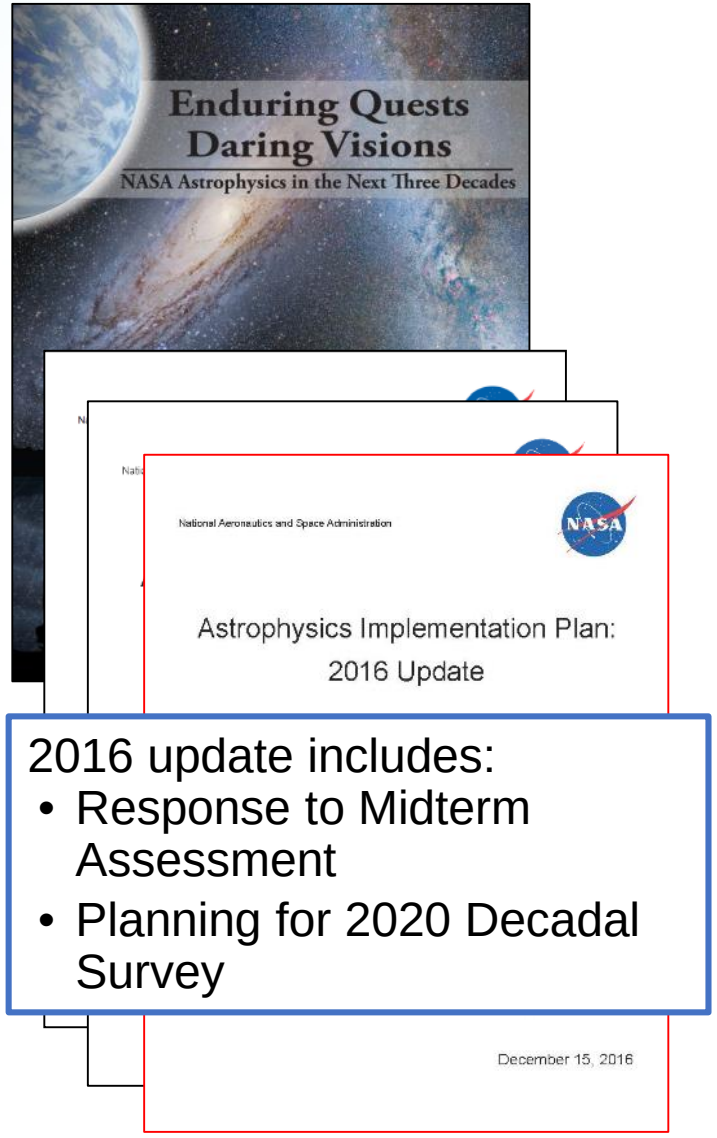
NASA Astrophysics
Planning for Astro2020

Astrophysics Strategic Planning

To be updated in 2018 (per GPRAMA)







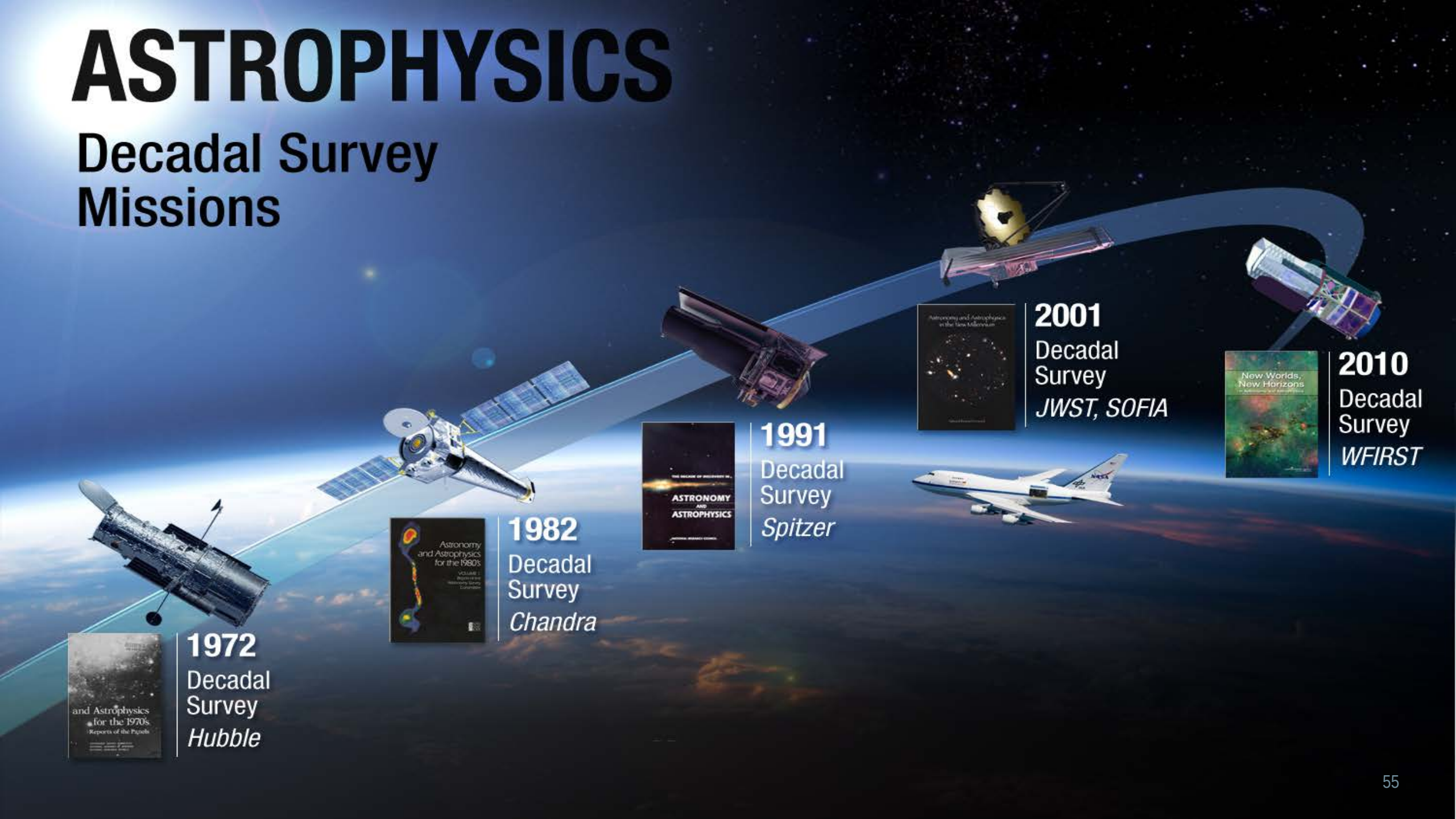
2016 update includes:

- Response to Midterm Assessment
- Planning for 2020 Decadal Survey

https://science.nasa.gov/astrophysics/documents

ASTROPHYSICS

Decadal Survey Missions



Decadal Survey Planning

- NASA's highest aspiration for the 2020 Decadal Survey is that it be ambitious.
  - The important science questions require new and ambitious capabilities.
  - Ambitious missions prioritized by previous Decadal Surveys have always led to paradigm shifting understanding of the universe.

- There are two areas where NASA has recently worked to ensure an ambitious Decadal Survey:
  - The timing of the Decadal Survey.
  - The scope of the large mission studies.

Decadal Survey Timing

- NASA AA for Science Thomas Zurbuchen expressed concern about whether an ambitious and forward-looking Decadal Survey could take place during a period of uncertainty regarding Webb and WFIRST
  - He charged the community with considering whether there was any alternative to delaying the Decadal Survey
- National Academies Astro2020 consultation group and leadership of CAA, SSB, and BPA discussed the issue.
  - Considered input from the community survey conducted by NASA's Program Analysis Groups (https://cor.gsfc.nasa.gov/copag/rfi/copag-rfi.php)
- Academies group recommended that the start of the Astro2020 Decadal Survey not be delayed
- On May 24, Zurbuchen accepted the recommendation
  - Zurbuchen explained in blog entry at https://blogs.nasa.gov/drthomasz/

Decadal Survey Planning

- NASA has initiated studies for large (Flagship) and medium (Probe) size mission concepts to inform the 2020 Decadal Survey Committee in an organized and coherent way
  - Main purpose is to provide the Decadal Survey Committee with several well-defined mission concepts to facilitate their deliberations
- Specifically, NASA is:
  - Sponsoring 4 community-based Science and Technology Definition Teams (STDTs) to partner with a NASA Center-based engineering team and study large (strategic) mission concept studies selected from the NASA Astrophysics 30-year Visionary Roadmap, a community-based report, and the 2010 Decadal Survey
  - Supporting 10 PI-led Study Teams for Probe-size mission concept studies, selected competitively
  - Supporting several other planning activities / studies / white papers
- All material related to NASA's 2020 Decadal Survey planning activities are posted at https://science.nasa.gov/astrophysics/2020-decadal-survey-planning

Decadal Survey Planning
Large Mission Concept Studies

- All four STDTs have submitted interim reports to NASA
  - These reports are being reviewed by an independent review team
  - Feedback will be provided to the STDTs to allow them to improve their final reports
- The interim reports contain each STDT's Architecture A (large version)
- NASA has directed the STDTs to develop a smaller Architecture B during the next year
  - This will provide the Decadal Survey with ranges of scientific scope for their missions, as well as a range of science goals at different budget levels
  - This was recommended by the NAS study "Powering Science" (2017)
  - All were already considering a smaller Architecture B
- NASA expects that all of the architectures (large and small) may be submitted to the Decadal Survey for consideration

Decadal Survey Planning
Large Mission Concept Studies

	Community STDT Chairs	Center Study Scientist	Study Lead Center	HQ Program Scientist
Habitable Exoplanet Imaging Mission www.jpl.nasa.gov/habex	Scott Gaudi Sara Seager	Bertrand Mennesson	JPL	Martin Still
Large UV/Optical/IR Surveyor asd.gsfc.nasa.gov/luvoir	Debra Fischer Bradley Peterson	Aki Roberge	GSFC	Mario Perez
Lynx X-ray Surveyor wwwastro.msfc.nasa.gov/lynx	Feryal Ozel Alexey Vikhlinin	Jessica Gaskin	MSFC	~~Dan Evans~~* Rita Sambruna
Origins Space Telescope asd.gsfc.nasa.gov/firs	Asantha Cooray Margaret Meixner	David Leisawitz	GSFC	Kartik Sheth

* Dan Evans is on detail to OMB through July 2018

Decadal Survey Planning
Probe Mission Concept Studies

PI	Affiliation	Short title
Jordan Camp	NASA GSFC	Transient Astrophysics Probe
Asantha Cooray	Univ. California, Irvine	Cosmic Dawn Intensity Mapper
Bill Danchi	NASA GSFC	Cosmic Evolution through UV Spectroscopy Probe
Jason Glenn	Univ. of Colorado	Galaxy Evolution Probe
Shaul Hanany	Univ. of Minnesota	Inflation Probe
Richard Mushotzky	Univ. of Maryland	High Spatial Resolution X-ray Probe
Angela Olinto	Univ. of Chicago	Multi-Messenger Astrophysics Probe
Peter Plavchan *	Missouri State Univ.	Precise Radial Velocity Observatory
Paul Ray	Naval Research Lab	X-ray Timing and Spectroscopy Probe
Sara Seager *	MIT	Starshade Rendezvous Mission

* Partial Selections

The Selection Document and Probes Implementation Plan are posted at
https://science.nasa.gov/astrophysics/2020-decadal-survey-planning

Decadal Survey Planning
Other NASA-sponsored Input

NASA HQ is sponsoring, planning, or contemplating several additional studies as input

- These are independent of studies being initiated and conducted by NASA scientists at NASA Centers without HQ sponsorship

- Balloon Program Roadmap
  - Conducted by community-based Roadmap team chaired by Peter Gorham (U Hawaii)
- Evolution of NASA Data Centers
  - In planning stage, draws on efforts including STScI study on big data, NASA Big Data Task Force on adapting archives to technology, and IPAC led study of joint data processing from LSST/Euclid/WFIRST
- SmallSats
  - RFI for Astrophysics science and technology concepts; ROSES call for Mission Concept Proposals
- In-Space Servicing/In-Space Assembly
  - NASA-led study initiated, joint SMD/STMD/HEOMD
- System-Level Segmented Telescope Technology Program
  - Initial selections announced March 2018 (selected teams led by Ball Aerospace and Lockheed Martin)
- NASA asked the CAA to provide input on its Decadal Planning activities by Sep 2018

Take Away

- R&A opportunities increasing
- Explorers AOs and launches proceeding at high cadence
- TESS science mission begins this month
- Webb independent review will lead to new launch date
- WFIRST beginning Phase B
- Decadal Survey planning proceeding with goal of an ambitious science program in the 2020s


+ MIDEX/MO (2023), SMEX/MO (2025), etc.
Spitzer 8/25/2003
Kepler 3/7/2009
Formulation
Implementation
Primary Ops
Extended Ops
WFIRST Mid 2020s
Webb 2020
Euclid (ESA) 2020
Chandra 7/23/1999
XMM-Newton (ESA) 12/10/1999
TESS 4/18/2018
NuSTAR 6/13/2012
Swift 11/20/2004
Fermi 6/11/2008
IXPE 2021
Hubble 4/24/1990
XARM (JAXA) 2021
ISS-NICER 6/3/2017
ISS-CREAM 8/14/2017
GUSTO 2021
SOFIA Full Ops 5/2014
Revised April 19, 2018 Consistent with FY18 Appropriation
+ Athena (late 2020s), LISA (mid 2030s)